

The invention features a method for injecting a fluid into a woody plant (*e.g.*, a tree (*e.g.*, a dicotyledon, a gymnosperm), a palm tree, a woody vine (*e.g.*, grapevine)), comprising providing (1) a fluid reservoir containing a fluid, (2) a gas reservoir containing a gas, (3) a needle having a proximal end and a distal end, where the needle comprises (a) an inner conduit, (b) a sealed tip terminating in a point at the distal end, (c) an outer surface, and (d) at least one aperture connecting the inner conduit and the outer surface and proximate to the point at said distal end, (4) an injector connecting the fluid reservoir and the gas reservoir to the proximal end of the needle, where the injector can direct at least a portion of the fluid from the fluid reservoir with at least one piston actuated by at least a portion of the gas from the gas reservoir, through the inner conduit of the needle and out of at least one of the apertures; then inserting the needle into the woody plant, and injecting, via the injector, at least a portion of the fluid from the fluid reservoir using at least a portion of the gas from the gas reservoir, through the inner conduit of the needle and out of the at least one aperture and into the woody plant; thereby injecting the fluid into the woody plant. The method can be repeated one or more times on the same woody plant. The fluid can be a treatment for a disease condition, or an insect infestation. The fluid can be a nutrient. The fluid can be aqueous, oleaginous, a suspension, or a combination thereof. The needle can be inserted into expansion tissue. The needle can include two apertures. One or more apertures connecting the inner conduit and the outer surface can be at a forward angle relative to the longitudinal axis of the needle, *e.g.*, the one or more apertures can be at an angle in the range of about 50° and about 130° relative to the longitudinal axis of the needle, or in the range of about 60° and about 120° relative to the longitudinal axis of the needle, or about 65° relative to the longitudinal axis of the needle. At least a portion of the outer surface of the needle between the point and one of the apertures can include a taper. The needle can have a first portion from the proximal end to a shoulder point, where the outer surface of the first portion can have a first taper, and the needle can also have a second portion from the shoulder point to the distal end, where the second portion can have a second taper which is substantially greater than the first taper. The second taper can have an angle in the range of about 10° and about 50° relative to the longitudinal axis of the needle, or in the range of about 20° and about 40° relative to the

longitudinal axis of the needle, or about 30° relative to the longitudinal axis of the needle. At least one of the apertures can be located between the shoulder point and the proximal end.

The invention also features a method for injecting a medicament (*e.g.*, a fertilizer, a pesticide, a fungicide, a growth regulator and a hormone) into a plant, comprising providing a medicament for a plant, providing a compressed gas (*e.g.*, carbon dioxide, air, nitrogen) for injecting the medicament into the plant, and injecting, by motion of at least one piston actuated by at least a portion of the compressed gas, medicament through a surface of the plant to inject the medicament into the plant. As a propellant, air is frequently divided into three basic categories: (1) low pressure air ("LPA"), which is generally less than 1,207 kiloPascals (175 pounds per square inch), medium pressure air ("MPA"), which is generally 1,207 - 2,586 kiloPascals (175 - 375 pounds per square inch), and high pressure air ("HPA"), which is generally greater than 2,586 kiloPascals (375 pounds per square inch).

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Please replace the paragraph at page 4, line 9 through page 5, line 7 with the following paragraph:

In another aspect, the invention features an apparatus for injecting a fluid into a woody plant (*e.g.*, a tree (*e.g.*, a dicotyledon, a gymnosperm), a palm tree, a woody vine (*e.g.*, grapevine)), comprising, (a) a fluid reservoir containing a fluid, (b) a gas reservoir containing a gas, (c) a needle having a proximal end and a distal end, comprising (i) an inner conduit, (ii) a sealed tip terminating in a point at the distal end, (iii) an outer surface, and (iv) at least one aperture connecting the inner conduit and the outer surface and proximate to the point at said distal end and (c) an injector connecting the fluid reservoir and the gas reservoir, wherein the injector can direct at least a portion of the fluid from the fluid reservoir with at least one piston actuated by at least a portion of the gas from the gas reservoir, through the inner conduit of the needle and out of the at least one aperture. The fluid can be a treatment for a disease condition, or an insect infestation. The fluid can be a nutrient. The fluid can be aqueous, oleaginous, a suspension, or a combination thereof. The needle can include two apertures. One or more apertures connecting the inner conduit and the outer surface can be at a forward angle relative to the longitudinal axis of the needle, *e.g.*, the one or more apertures can be at an angle in the range

*P2*

of about 50° and about 130° relative to the longitudinal axis of the needle, or in the range of about 60° and about 120° relative to the longitudinal axis of the needle, or about 65° relative to the longitudinal axis of the needle. At least a portion of the outer surface of the needle between the point and one of the apertures can include a taper. The needle can have a first portion from the proximal end to a shoulder point, where the outer surface of the first portion can have a first taper, and the needle can also have a second portion from the shoulder point to the distal end, where the second portion can have a second taper which is substantially greater than the first taper. The second taper can have an angle in the range of about 10° and about 50° relative to the longitudinal axis of the needle, or in the range of about 20° and about 40° relative to the longitudinal axis of the needle, or about 30° relative to the longitudinal axis of the needle. At least one of the apertures can be located between the shoulder point and the proximal end.

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Please replace the paragraph at page 8, lines 13 through 18 with the following paragraph:

*P3*

In one embodiment, the apparatus comprises a needle, a fluid reservoir which holds the fluid to be injected into the plant, and a gas reservoir which holds a gas. The gas is used to propel the fluid through the needle and into the plant. The gas can include, but is not limited to, carbon dioxide and nitrogen.

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Please replace the paragraph at page 11, line 23 through page 12, line 5 with the following paragraph:

*P4*

In another embodiment, shown in Fig. 6, the gas is introduced into the HPA inlet port 101, shuttled into the power piston 125 via the shuttle valve 115 by depressing the trigger 110. The shot size is set by the shot size adjustment knob 120, which limits the return travel of the power piston 125. Once the power piston 125 is actuated, it pushes the injector rod 130, closing the inlet check valve 140 and opening the outlet check valve 145 at a set pressure that is adjustable via spring selection. When the trigger 110 is released, the shuttle valve 115 closes to HPA and opens to the HPA exhaust position 105 and the power piston 125 is allowed to return to the shot start set point. This draws back the injector rod 130, closing the outlet check valve 145

*B4*  
and opening the inlet check valve 140 to receive whatever positive pressure fluid is available at inlet port 135. As the pressure created by the outlet check valve 145 spring is still collapsing in the injection needle 150, there is no fluid "suck back".

Please replace the paragraph at page 13, lines 11-15 with the following paragraph:

*B5*  
Once the tip of the needle is placed at a satisfactory location for injection, the apparatus is triggered, and at least a portion of the fluid from the fluid reservoir is pushed with at least a portion of the gas from the gas reservoir, into the proximal end of the needle, through the inner conduit of the needle, and out of at least one of the aperture(s), and into the plant.

Please replace the paragraph at page 14, lines 6-7 with the following paragraph:

*B6*  
After treatment, the plant should be watered thoroughly, e.g., 2.54 cm (1 inch) of irrigation in the root zone, to ensure distribution of the medicament throughout the plant.

Please replace the paragraph at page 16, lines 14-24 with the following paragraph:

*B7*  
Other suitable injection compositions include botanical and herbal products, e.g., organic plant extracts specifically formulated to increase natural plant defense mechanisms, to be used as prophylaxis or deterrents to infestation and/or infection by pests. Such compositions include, but are not limited to, extracts of *Allium* (e.g., *A. cepa* (onion) and/or *A. sativum* (garlic); as prophylaxis, to enhance plant defenses against infection, as natural sulfonated compounds reduce susceptibility to infection), *Capsicum* (*C. annuum* (hot pepper); as prophylaxis, as such extracts reduce plant desirability as a food source), and *Lycopersicon* (*L. esculentum* (tomato); enhances plant resistance to infestation). Other compositions include biocontrols, e.g., injection of predatory nematodes into cavities, to control plant borers, e.g., red palm weevil, Asian long horned beetle, etc.